

EXHIBIT “13”

Massachusetts Bay Transportation Authority
Red Line Extension Northwest

STATUS REPORT
ON THE MONITORING PROGRAM FOR
GROUNDWATER QUALITY
IN THE SLUDGE SOLIDIFICATION AREA

prepared by

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DPW00402

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I INTRODUCTION

The proposal for the solidification of the sludge material disposed of on W. R. Grace property and lying on the proposed alignment of the Red Line Extension Northwest was formally presented to the Cambridge Conservation Commission in a Notice of Intent, as required by the Massachusetts Wetlands Protection Act, on August 29, 1980. The proposal called for the sludge material, a waste product from W. R. Grace's manufacturing operation, to be converted to an insoluble, inert material by a chemical process. The processed material would then be removed to a site outside the City of Cambridge which would meet any requirements set by the Department of Environmental Quality Engineering.

A public hearing regarding the sludge solidification program was held on September 2, 1980. The Cambridge Conservation Commission agreed with the intent of the program in principle but wished to include some restrictions on the operation and some provisions for monitoring the long term affects of the sludge materials. These restrictions and monitoring requirements were reflected in the Order of Conditions of October 9, 1980. Two of the conditions, number 16 and number 17, related specifically to groundwater issues. These are as follows:

"16. Prior to the commencement of any work hereunder, the applicant shall develop a monitoring program, in consultation with the Water Department of the City of Cambridge, and submit to the Commission, and the Commission shall have approved said program, which program shall assure that the groundwater on the site, which potentially may flow from the site, will not contain any water contaminants.

17. If said monitoring as provided in paragraph 16 indicates that water, which potentially may flow from the site, will contain water contaminants, the applicant shall take such reasonable measures as the Commission may require to ensure that said water will not contain contaminants."

The sludge was solidified during the spring of 1981 and the material was later removed to a sanitary landfill in Kingston, Massachusetts. Construction of the subway tunnel is currently taking place on the site under the Massachusetts Bay Transportation Authority's Construction Contract 091-508A and Construction Contract 091-601.

The remainder of this report briefly describes the program which was originally proposed to meet the groundwater monitoring requirements of the Order of Conditions, subsequent developments as the program was carried out, and continuing efforts to monitor groundwater in the sludge solidification area as the construction process has taken place.

II THE MONITORING PROGRAM AS ORIGINALLY PROPOSED

Because of the extensive soil and groundwater analysis program carried out for the design of the tunnel by Goldberg-Zoino & Associates, geotechnical consultant for the project, and the analysis of the sludge problem by both Goldberg-Zoino & Associates and by Haley and Aldrich, who were retained independently by W. R. Grace and Co., several monitoring locations were in existence in the general area of the sludge solidification operation. It was determined that only one additional observation well in addition to those monitoring locations already existing would be sufficient to provide information as required in the Order of Conditions. The original proposal assumed twelve monitoring locations (See Figure 1 "Monitoring Equipment Locations").

It was realized at this time that some of the existing monitoring locations would eventually be destroyed during the construction of the tunnel across the site. Since the groundwater quality was anticipated to improve significantly when the sludge was removed, it seemed likely there would be no need to replace these monitoring locations after they were destroyed.

It had been determined in previous analyses by both Goldberg-Zoino & Associates, and Haley and Aldrich that the sludge materials contained large amounts of sulfates and, consequently, that the groundwater contaminated by the sludge contained relatively high degrees of sulfate ions. The degree of sulfate concentration is related to the electrical conductivity of the groundwater and it was anticipated that once this relationship was definitively established testing for conductivity alone would be sufficient to provide an indication of the changing quality of the groundwater (See Figure 2 "Relationship Between Conductivity and Sulfate Concentration").

The collection and testing of samples was to take place on the following schedule:

- o Just prior to the removal of the sludge material to provide a base level or existing conditions measurement.
- o Just after complete removal of the sludge material.
- o Monthly for six months subsequent to the removal of the sludge material.
- o Every other month for the next six months.

It was anticipated that sufficient improvement in groundwater quality would be shown in the year after the removal of sludge material that no further testing would be required.

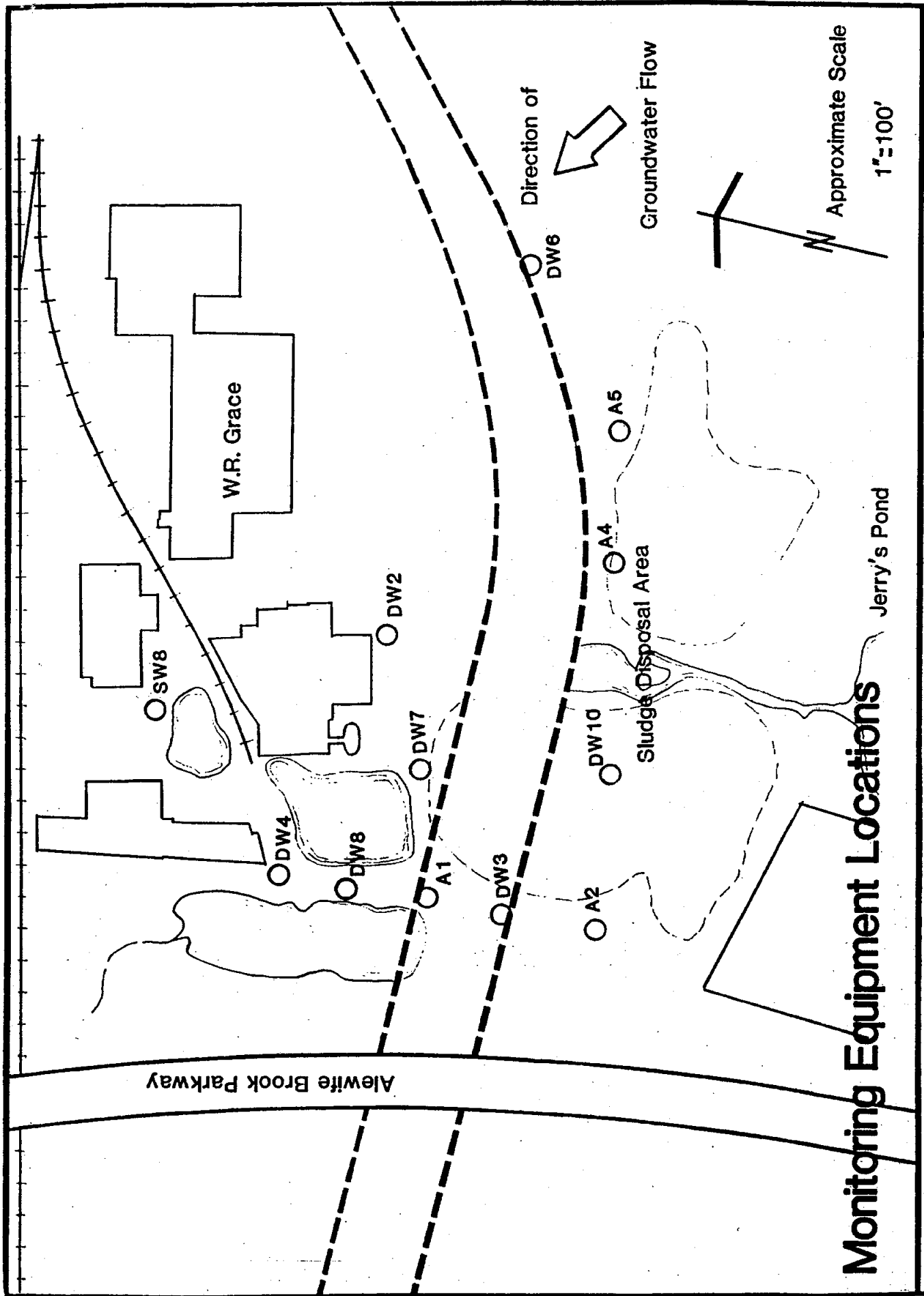
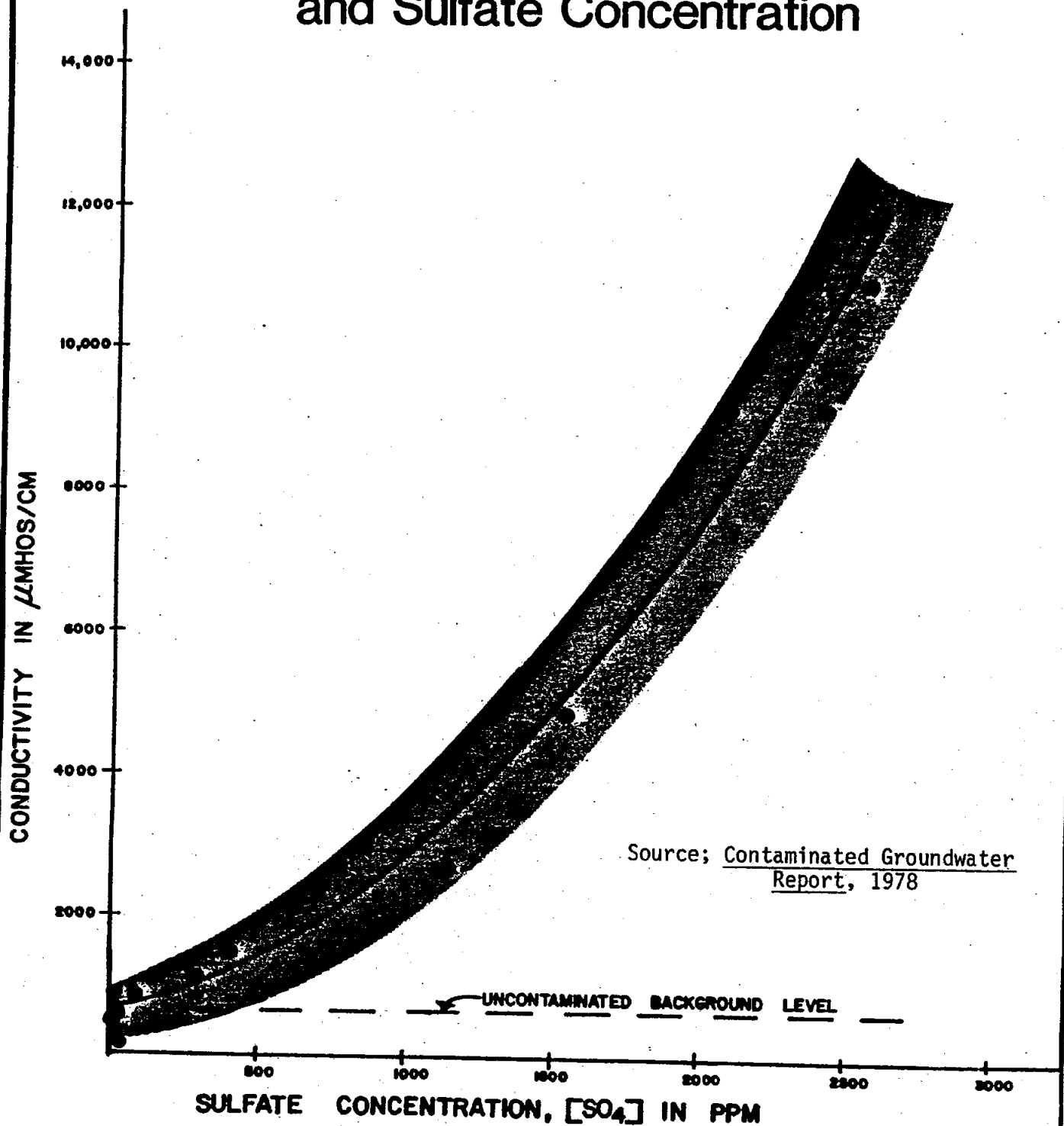


FIGURE 1

GROUNDWATER MONITORING

Monitoring Equipment Locations

Relationship Between Conductivity and Sulfate Concentration



GROUNDWATER MONITORING

FIGURE 2

DPW00408

III DATA READINGS OBTAINED

Unfortunately, the proposed monitoring program was not able to be successfully carried out. The construction activity associated with the sludge solidification operation destroyed most of the monitoring instrumentation and subsequent tunnel construction activity destroyed all except one of the observation wells. However, data readings were obtained prior to the sludge solidification and removal process and these will be able to serve as a basis for comparison with future information.

The following is a compendium of the information that has been obtained through the monitoring program:

A. READINGS BEFORE SLUDGE SOLIDIFICATION AND REMOVAL

Long term trends on the site have been recorded at three multi-level monitoring locations, (1) observation well A-1, (2) observation well A-2, and (3) observation well A-4. Periodic readings of conductivity were taken at these locations at all three levels dating back to September 1978 (See Figure 3 "Conductivity Trends at Observation Wells A-1, A-2, and A-4"). Periodic readings were also taken at wells installed on the site by Haley and Aldrich for W. R. Grace. This information is not considered as reliable as that from wells A-1, A-2, and A-4 because of interstratum mixing, but is presented as background material along with readings from wells A-1, A-2, and A-4 in Figure 4 "Conductivity Readings". This is a complete record of all readings taken as part of the groundwater monitoring program.

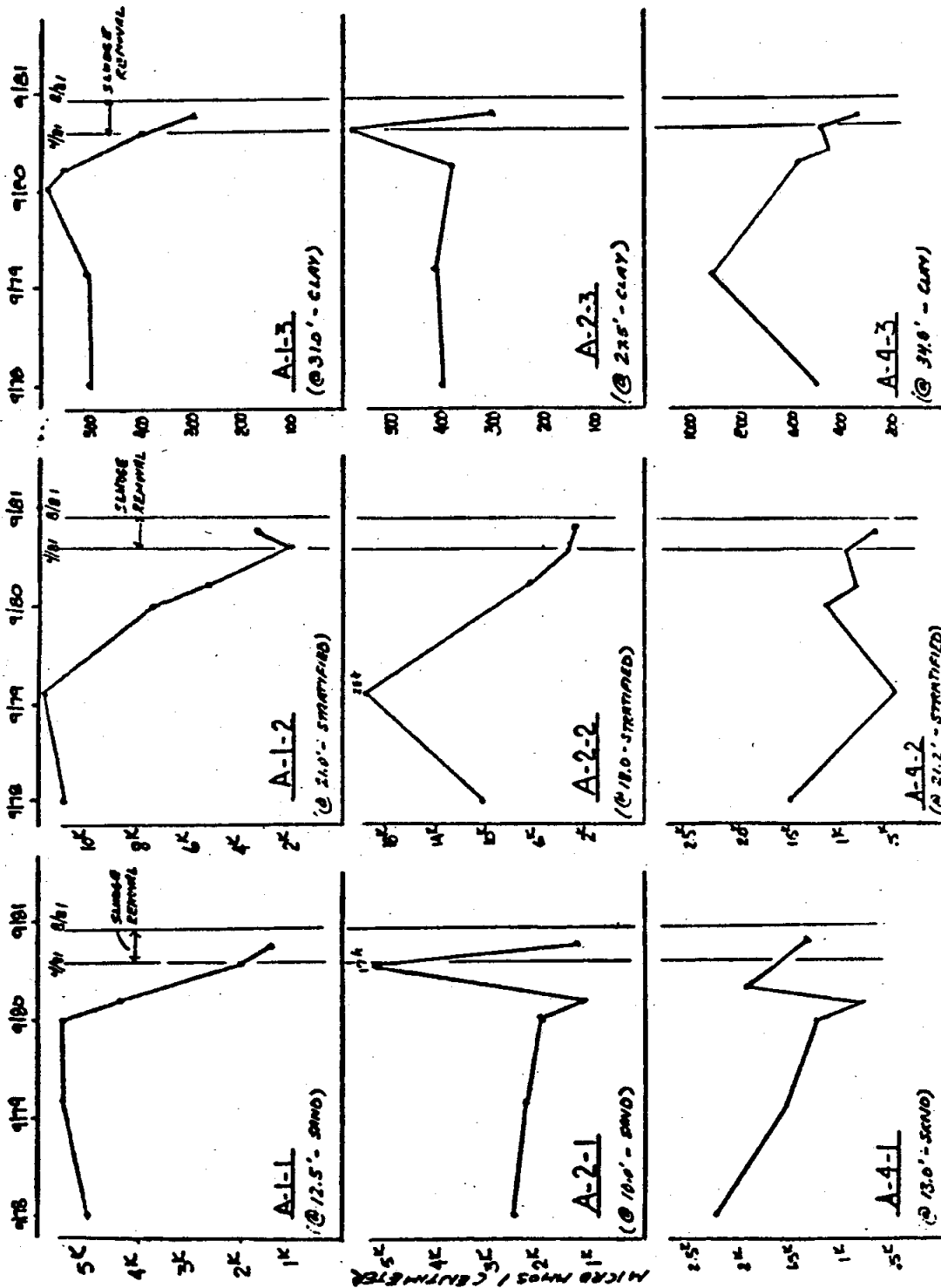
An extensive field analysis was conducted in 1978 involving 25 locations in the sludge solidification area. In many cases a laboratory analysis was also performed. This material is contained in the Contaminated Groundwater Report of December 1978 and provides a good indication of groundwater conditions on the site prior to any sludge removal or tunnel construction activity.

A field analysis is available for observation wells A-1, A-2, and A-4 and a laboratory analysis is available for observation wells A-1 and A-4 (see Figures 5, 6, and 7).

This material provides an initial cross reference between sample conductivity at these locations, pH readings, and chemical makeup.

B. READINGS AFTER SLUDGE SOLIDIFICATION AND REMOVAL AND BEFORE TUNNEL CONSTRUCTION

Because of the extensive destruction of monitoring equipment, the fact that stockpiles of solidified sludge material, for which removal was delayed, made some areas inaccessible, and the very short time span between the end of sludge removal and the beginning of tunnel construction, no measurements were made during this interim period.



Conductivity Trends at Observation Wells A1,A2, and A4

GROUNDWATER MONITORING

FIGURE 3

Observation Well

Date

	9/78	11/79	7/80	11/80	4/81	6/81	7/82	11/82
A-1-1	4700	5000	5500	4300	2100	1290		
A-1-2	10,700	12,000	7500	5200	2000	3550		
A-1-3	510	510	620	560	400	310		
A-2-1	2650	2300	2000	1200	17000	1290		2500
A-2-2	13100	28000	—	7000	28000	5500	3810	22500
A-2-3	400	420	—	320	100	300	—	500
A-4-1	2400	1600	1310	820	2000	1420		
A-4-2	1470	520	1200	700	1000	700		
A-4-3	540	430	590	420	500	350		
A-5-1					4000	3600		
A-5-2					2900	1950		
A-5-3					170	150		
DW-2-1		1600						
DW-2-2		26000						
DW-2-3		28000						
DW-2-4		480						
DW-3-1		5600			2700	6000		
DW-3-2		21000			3200	—		
DW-3-3		12000			495	7000		
DW-3-4		520			250	—		
DW-4-1		4500						
DW-4-2		4800						
DW-4-3		5600						
DW-4-4		2700						
DW-6-1		200						
DW-6-2		120						
DW-6-3		220						
DW-6-4		340						
DW-7-1		3000			—	—		
DW-7-2		15000			4150	—		
DW-7-3		5100			5000	4320		
DW-7-4		7300			—	5500		
DW-8-1		3300			1700	—		
DW-8-2		19000			6500	8100		
DW-8-3		12000			—	—		
DW-8-4		580			380	1300		
DW-10-1		3100			1300	—		
DW-10-2		3000			—	—		
DW-10-3		2300			3800	—		
DW-10-4		2700			3600	4250		
DW-10-5		—			450	700		
SW-8		5200						

Conductivity Readings

DPW00411

SAMPLE INVENTORY AND FIELD ANALYSIS

Date	Well #	Color	Odor	Salinity ‰	Conductivity µmhos/cm	pH (Field)	Ground Water Depth (Ft. BGS)	Ground Water Elev.
5/27/78	A-1-1	—	Moderate	—	—	—	3.6	109.0
5/27/78	A-1-2	—	Very Strong	—	—	5.0-5.5	—	—
5/27/78	A-1-3	—	Slight	—	—	5.0-5.6	—	—
7/27/78	A-1-1	—	Very Strong	—	—	3.0	—	—
7/27/78	A-1-2	—	Very Strong	—	—	5.0	—	—
7/27/78	A-1-3	—	None	—	—	6.5	—	—
8/28/78	A-1-1	Orange Brown	Moderate	2.2	4,200	3.3	2.8	109.8
8/28/78	A-1-2	Orange Brown	Moderate	3.8	11,000	5.7	—	—
8/28/78	A-1-3	—	None	0.0	620	8.2	—	—
9/7/78	A-1-1	Orange Brown	Strong	3.0	4,850	3.7	3.2	109.4
9/7/78	A-1-2	Orange Brown	Strong	6.9	10,900	5.7	—	—
9/7/78	A-1-3	—	None	0.0	490	8.4	—	—
9/25/78	A-1-1	Orange Brown	Strong	3.0	5,000	3.8	3.9	108.7
9/25/78	A-1-2	Orange Brown	Strong	6.8	10,900	5.8	—	—
9/25/78	A-1-3	—	Very Slight	0.0	500	7.8	—	—
10/11/78	A-1-1	—	—	—	—	—	3.4	109.2
10/17/78	A-1-1	—	—	—	—	—	2.8	109.8

NOTE: Sampling intervals:

A-1-1 → 2.5' to 12.5' below ground surface (Elev. 100.0 to 110.1)

A-1-2 → 20' to 22' below ground surface (Elev. 90.6 to 92.6)

A-1-3 → 30' to 32' below ground surface (Elev. 80.6 to 82.6)

LABORATORY ANALYSIS

Well #	Conductivity		pH		Acidity	Alkalinity	Chloride	Calcium	Magnesium	Iron	Sulfate
	Field	Lab	Field	Lab							
A-1-1	5,000	4,900	3.8	3.3	240	—	149	560	82.69	102.75	1546.3
A-1-2	10,900	10,900	5.8	4.6	—	110	798	440	972.80	3206.00	2569.4
A-1-3	500	510	7.8	7.0	—	140	133	8	4.86	20.97	28.7

NOTES: (1) All concentrations reported in parts per million.
 (2) Sample collected 9/25/78; analysis 11/15/78.

Source: Contaminated Groundwater
Report, 1978

Data at Observation Well A1

GROUNDWATER MONITORING

FIGURE 5

Date	Well #	Color	Odor	pH (Field)	Conductivity (μmhos/cm)	Salinity o/oo	Groundwater (Ft. BGS)	Groundwater Elevation	Remark
9/11/78	A-2-1	—	—	—	—	—	—	—	Sampled three hours after completion.
9/11/78	A-2-2	pale yellow	slight	6.7	1,630	0.5	—	—	"
9/11/78	A-2-3	light gray	none	8.0	460	0.0	—	—	"
9/25/78	A-2-1	orange brown	mod	6.5	2,650	1.1	—	—	Slight oil film? No chemical analysis.
9/25/78	A-2-2	light brown	strong	6.2	13,100	8.2	—	—	"
9/25/78	A-2-3	none	none	8.1	400	0.0	—	—	"
10/17/78	A-2-1	—	—	—	—	—	4.9	109.4	"

NOTES: (1) No laboratory analyses were performed on samples from these wells.

(2) Intervals sampled:

A-2-1 1' to 10' below ground surface (Elev. 103.1 to 112.1)

A-2-2 17' to 19' below ground surface (Elev. 94.1 to 96.1)

A-2-3 26.5' to 28.5' below ground surface (Elev. 84.6 to 86.6)

Source; Contaminated Groundwater Report, 1978

Data at Observation Well A2

GROUNDWATER MONITORING

FIGURE 6

SAMPLE INVENTORY AND FIELD ANALYSIS

Date	Well #	Color	Odor	Salinity ‰	Conductivity μmhos/cm	pH (Field)	Ground Water Depth (Ft.BGS)	Ground Water Elev.
9/14/78	A-4-1	Pale Yellow	Moderate	1.0	1920	6.6	5.3	109.1
9/14/78	A-4-2	Faint Yellow	Slight	0.1	970	8.0	—	—
9/14/78	A-4-3	None	None	0.0	460	8.2	—	—
9/25/78	A-4-1	Pale Orange	Moderate	1.0	2350	6.5	5.6	108.8
9/25/78	A-4-2	None	Slight	0.5	1560	7.9	—	—
9/25/78	A-4-3	None	Very Slight	0.0	520	8.0	—	—
10/11/78	A-4-1	—	—	—	—	—	5.5	108.9
10/17/78	A-4-1	—	—	—	—	—	4.0	110.4

NOTE: Sampling intervals:

A-4-1 → 4.5' to 13' below ground surface (Elev. 101.4 to 109.9)

A-4-2 → 20.2' to 22.2' below ground surface (Elev. 92.2 to 94.2)

A-4-3 → 33.8' to 35.8' below ground surface (Elev. 78.6 to 80.6)

LABORATORY ANALYSIS

Well #	Conductivity		pH		Acidity	Alkalinity	Chloride	Calcium	Magnesium	Iron	Sulfate
	Field	Lab	Field	Lab							
A-4-1	2350	2400	6.5	7.0	—	390	66	640	25.3	23.1	1140.8
A-4-2	1560	1470	7.9	7.2	—	244	103	140	36.5	2.1	422.2
A-4-3	520	540	8.0	7.7	—	90	193	56	7.3	1.4	16.3

NOTES: (1) All concentrations reported in parts per million.

(2) Sample collected 9/25/78; analyzed 11/15/78.

Source; Contaminated Groundwater
Report, 1978

Data at Observation Well A4

GROUNDWATER MONITORING

FIGURE 7

C. READINGS SINCE TUNNEL CONSTRUCTION HAS BEGUN

Readings since construction has begun are limited because most of the monitoring equipment was destroyed early in the tunnel construction process through slurry wall construction, the movement of equipment, or through the stockpiling of material. Since tunnel construction began in 1981 only one monitoring location has remained in use, observation well A-2. A measurement was taken here in September 1982 and again in November 1982.

D. CONTINUOUS READINGS IN ONE LOCATION

As a result of the unanticipated losses of the monitoring equipment, continuous readings are available for only one observation well, number A-2, located adjacent to Alewife Brook Parkway and south of the tunnel.

The readings from one location cannot be considered as representative of the entire site especially since observation well A-2 is located in an area of previous high contamination. In any case, the conductivity of the samples, which is indicative of the sulfate ion content of the groundwater, despite some intermediate fluctuations, shows no lessening from the levels measured in 1978, 1979, and 1980 prior to the removal of the sludge material (See Figure 8 "Continuous Readings at Observation Well A-2").

<u>Date</u>	<u>pH</u>	<u>Conductivity (μ MHO)</u>
At Elevation 103 (approximately 10' below ground level):		
9-78	6.5	2500
9-79	-	2200
9-80	6.5	2000
4-81	-	17000
6-81	-	1500
11-82	6.3	2500

At Elevation 95 (approximately 18' below ground level):		
9-78	6.2	10000
9-79	-	28000
9-80	6.2	6000
4-81	-	3000
6-81	-	2500
11-82	5.4	22500

At Elevation 86 (approximately 27' below ground level):		
9-78	8.1	400
9-79	-	400
9-80	8.1	600
4-81	-	650
6-81	-	300
11-82	7.3	500

Continuous Readings at Observation Well A2

IV CURRENT STATUS OF MONITORING EQUIPMENT

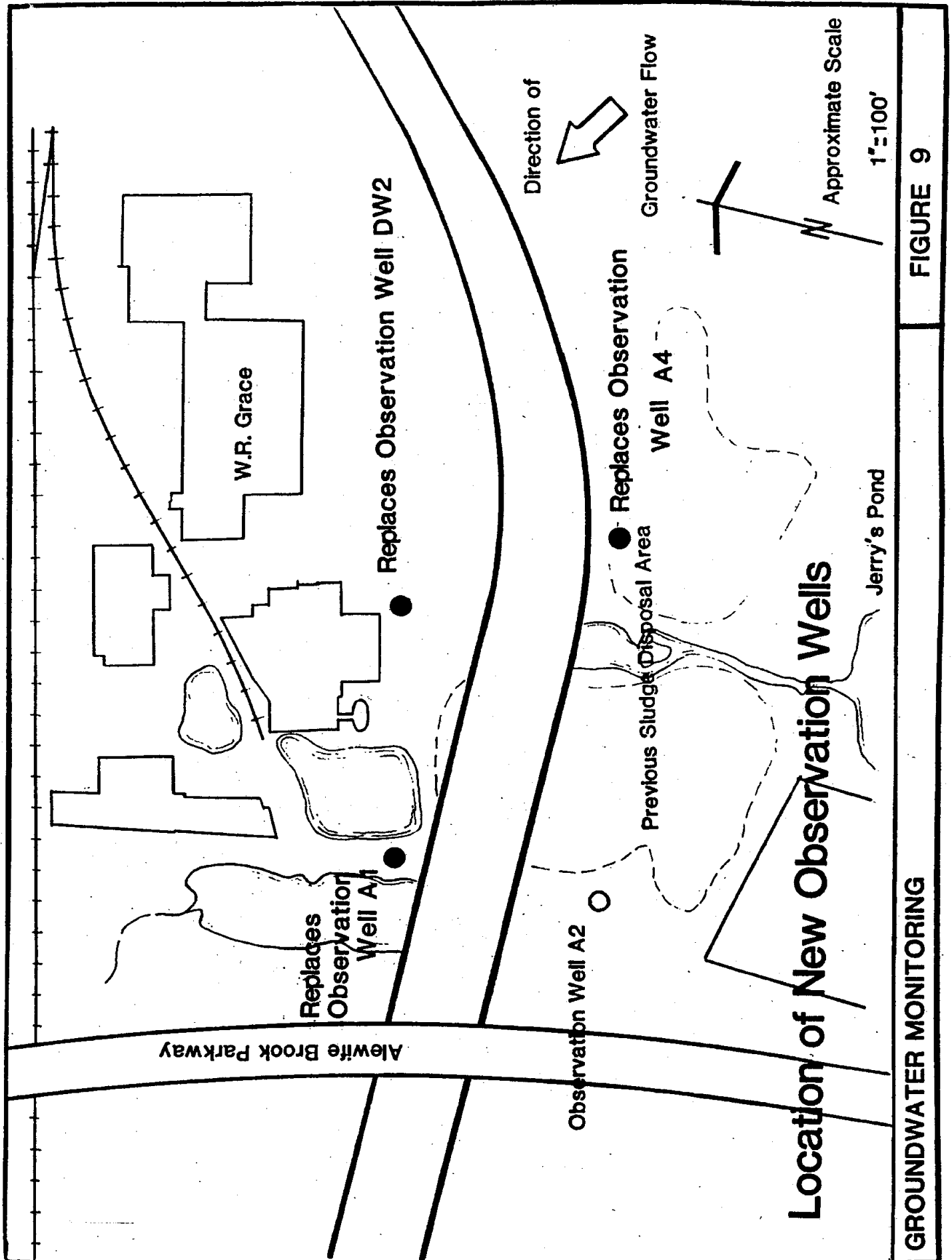
Observation Well A2 is still in existence and is still available for monitoring purposes. None of the previous monitoring locations are still in existence.

It was considered impractical to try to replace any of the monitoring equipment as they were destroyed since the operations that had eliminated them in the first place were still ongoing. At this point construction has progressed far enough so that replacement of some of the observation wells in the same location to provide a continuation of previously obtained data has been accomplished.

V PROPOSAL FOR FURTHER TESTING

Three new observation wells has been installed to supplement the very limited information on current site conditions provided by the one existing observation well. They are located both in the more average contamination areas, that is east of the sludge piles on the north and south sides of the tunnel alignment, and in the highly contaminated area on the north side of the tunnel opposite A-2, the existing observation well. The locations of these three new wells are shown on Figure 9 "Location of New Observation Wells".

The placement of these wells will allow for an evaluation of the dilution experienced in the groundwater as it moves down the groundwater gradient in the area of the tunnel and a comparison with previous readings at these locations. To assess this change, new readings will be taken after an initial stabilization period for the new wells is allowed for.



APPENDIX

Background Information on
the Sludge Solidification Problem

o	Groundwater Quality Data Summaries from the <u>Contaminated Groundwater Report, December 1978, by Goldberg, Zoino & Associates for field and laboratory analyses of samples taken at 25 locations in the sludge solidification area</u>	17
o	Results of a chemical analysis of a groundwater sample by NUS Corporation dated June 25, 1979 which identifies the compounds found and describes the testing procedure	26
o	Summary of Analytical Results of a groundwater sample from <u>Preliminary Toxic Hazard Evaluation at the Red Line Construction Site, September 1981 by GCA Corporation . . .</u>	28
o	Data Report for a groundwater sample analysis by GCA Corporation, September 18, 1981, and October 5, 1981	29
o	Analysis results for soil samples from <u>Analysis of Soil Samples from the Red Line Construction Site, November 1981, by GCA Corporation</u>	32
o	Correspondence from the Massachusetts Department of Environmental Quality Engineering dated June 16, 1981, classifying the solidified sludge material as a solid waste requiring no special handling	34
o	Correspondence from the Massachusetts Department of Environmental Quality Engineering dated November 1, 1982, confirming that soils contiguous to the previously removed solidified sludge material are not hazardous	36

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GROUNDWATER QUALITY DATA SUMMARYUNCASED AUGER HOLES

Date	Well #	Ground Water Temp. °C	Odor	pH (Field)	Conductivity μ mhos/cm	Salinity ‰	Water Table Depth	Water Table Elev.	Remark
8/28/78	A-101	17.6	None	6.1	880	0.0	3.7	108.3	
8/28/78	A-102	18	None	6.0	1080	0.1	3.5	108.5	
8/28/78	A-103	16.7	None	—	178	0.0	3.5	110.5	
8/28/78	A-104	18.2	None	—	580	0.0	4.4	108.6	
8/28/78	A-105	15.5	—	—	2520	0.8	5.5	112.5	
8/28/78	A-106	18	Slight	5.5	850	0.1	2.5	109.5	
8/28/78	A-107	19	Strong	7.4	1850	0.6	4.0	110.0	
8/28/78	A-108	17	Slight	5.8	1780	0.1	4.0	110.0	
8/28/78	A-109	15.8	Strong	5.3	2000	1.0	4.9	108.1	Pale orange brown
8/28/78	A-110	19.5	Slight	6.1	3500	1.8	4.5	108.5	Pale orange brown
8/28/78	A-111	19	Mod ¹	6.4	800	0.0	2.6	109.4	Distinct odor of alcohol. ¹
9/7/78	A-101	18	None	6.5	750	0	3.5	108.5	
9/7/78	A-102	18	None	6.2	950	0	3.9	108.1	
9/7/78	A-103	16.2	None	6.8	180	0	3.9	110.1	
9/7/78	A-104	19	Slight	6.2	520	0	4.7	108.3	
9/7/78	A-105	16.4	Slight	6.9	3000	1.5	5.7	112.3	
9/7/78	A-106	Hole collapsed			—	—	—	—	
9/7/78	A-107	Hole caved			—	—	—	—	
9/7/78	A-108	Hole caved			—	—	—	—	
9/7/78	A-109	Hole full of mud			—	—	4.1	108.9	
9/7/78	A-110	19	Slight	5.9	600	3.7	3.0	110.0	
9/7/78	A-111	19.2	Slight	6.7	780	0.1	2.9	109.1	

TABLE NO. 1745-W-1.9-4

December 20, 1978

PLATE NO. AGR-C-1

GROUNDWATER QUALITY DATA SUMMARY
SINGLE-LEVEL OBSERVATION WELLS

WELL INVENTORY AND FIELD ANALYSES											
Well #	Date	Color	Odor	pH (Field)	Conductivity μmhos/cm	Salinity o/oo	Groundwater		Interval Sampled		Remark
							Depth (Ft.BGS)	Elev.	Depth (Ft.BGS)	Elev.	
OW-4	9/7/78	Light Gray	None	6.6	290	0.0	5.1	107.7	5-13	99.8- 107.8	Water is clear
OW-4	9/25/78	Light Gray	None	6.3	310	0.0	5.1	107.7	5-13	99.8- 107.8	
OW-5	7/28/77	Yellow	Moderate	—	—	—	—	—	—	—	See 7/28/77 analysis below
OW-5	8/28/78	Dark Brown	Strong	1.9	4,000	2.2	—	—	—	—	
OW-5	9/7/78	Orange	Moderate	1.7	4,550	—	4.6	109.5	5.5	108.3	Strongly strat-
OW-5	9/7/78	Orange Brown	Strong	—	13,800	9.0	4.6	109.5	8.0	104.8	ified well
OW-5	9/7/78	Dark Brown	Strong	—	16,100	9.9	4.6	109.5	14.3	98.6	
OW-5	9/25/78	Dark Brown	Strong	2.5	10,000	6.1	4.9	109.2	5-15	98- 108	Bailed 3 Gals. before sample.

LABORATORY ANALYSES

Well#	Conductivity μmhos/cm		pH		Acidity	Alkalinity	Chloride	Calcium	Magnesium	Iron	Sulfate
	Field	Lab	Field	Lab							
OW-51	10,000	9250	2.5	1.9	1660	—	498	680	63.23	2573.7	2100.8
OW-52,3	—	—	—	2.4	—	—	498	—	—	—	3630.0

NOTES: (1) Sample collected 9/25/78; analyzed 11/15/78.
 (2) Sample collected 7/28/78.
 (3) Sulfide -S 3.00 ppm; Sulfide - H₂S 3.19 ppm.
 (4) All concentrations reported in parts per million.

TABLE NO. 1745-W-1.9-5

December 20, 1978

PLATE NO. AGR-C-2

DPW00422

GROUNDWATER QUALITY DATA SUMMARY
SINGLE-LEVEL OBSERVATION WELLS

WELL INVENTORY AND FIELD ANALYSES													
Well #	Date	Color	Odor	pH (Field)	Conductivity μ mhos/cm	Salinity o/oo	Groundwater		Interval Sampled		Remark		
							Depth (Ft. BGS)	Elev.	Depth (Ft. BGS)	Elev.			
OW-6	9/7/78	Pale Yellow	None	6.6	1550	0.5	5.1	108.3	6.6	106.8			
OW-6	9/25/78	Submerged under puddle — no sample possible											
LABORATORY ANALYSES													
Well #	Conduc-tivity μ mhos/cm Lab	pH Lab	Silica (SiO ₂)	Alkalinity (Ca CO ₃)	Chloride	Calcium	Magnesium	Iron and Aluminum Oxide	Sulfate (SO ₄)	Potassium	Sulfide (H ₂ S)	Hardness (Ca CO ₃)	Total Dissolved Solids
OW-6 ¹	1550	6.5	8.4	600	149.0	380	120	73.5	0.25	145	None	500	1306
NOTES: (1) Sample collected 3/5/78. (2) All concentrations in parts per million.													
TABLE NO. 1745-W-1.9-6													
December 20, 1978													
PLATE NO. AGR-C-3													

GROUNDWATER QUALITY DATA SUMMARY
SINGLE-LEVEL OBSERVATION WELLS

WELL INVENTORY AND FIELD ANALYSES										
Well #	Date	Color	Odor	pH (Field)	Conductivity μ mhos/cm	Salinity o/oo	Groundwater		Interval Sampled	
							Depth (Ft.BGS)	Elev.	Depth (Ft.BGS)	Elev.
A-7	9/7/78	Pale Yellow	None	7.2	1000	0.1	4.8	108.3	6.3	107
A-7	9/8/78	—	Very Slight	7.2	1250	—	4.8	108.3	6.3	107
A-7	9/8/78	—	Very Slight	7.2	1100	—	4.8	108.3	14.2	99
A-7	9/8/78	Pale Gray	Very Slight	7.1	1100	0.2	4.8	108.3	6.3	107
A-7	9/8/78	—	Very Slight	7.1	790	—	4.8	108.3	14.2	99
A-7	9/25/78	Light Gray	Very Slight	6.8	1630	0.6	4.8	108.3	5-15	98-108
A-7	10/11/78	—	—	—	—	—	4.6	108.5	—	—
A-7	10/17/78	—	—	—	—	—	4.3	108.8	—	—
A-8	9/7/78	—	None	—	360	—	3.8	109.1	5.3	108
A-8	9/8/78	—	None	6.7	250	0.0	3.9	109.0	5.4	108
A-8	9/8/78	—	None	6.8	312	0.0	3.9	109.0	12.8	100
A-8	9/25/78	—	None	6.6	220	0.0	4.0	108.9	—	—
A-8	10/11/78	—	—	—	—	—	4.0	108.9	—	—
A-8	10/17/78	—	—	—	—	—	3.5	109.4	—	—

2 hrs. after completion
9:00
9:00
12:00
12:00
See analysis below

LABORATORY ANALYSIS

Well #	Conductivity μ mhos/cm		pH		Acidity	Alkalinity	Chloride	Calcium	Magnesium	Iron	Sulfate
	Field	Lab	Field	Lab							
A-8	220	222	6.6	6.6	—	90	48	32	2.43	1.40	12.96

NOTES: (1) Sample collected 9/25/78; analyzed 11/15/78.
 (2) All concentrations reported in parts per million.

TABLE NO. 1745-W-1.9-7

December 20, 1978

PLATE NO. AGR-C-4

GROUNDWATER QUALITY DATA SUMMARYSINGLE-LEVEL OBSERVATION WELLS

Well #	Date	Color	Odor	pH (Field)	Conductivity	Salinity o/oo	Groundwater		Interval Sampled		Remark
							Depth (Ft.BGS)	Elev.	Depth (Ft.BGS)	Elev.	
A-9	9/8/78	pale gray	none	7.0	498	—	4.8	108.4	6.3	106.9	Slotted from 15'-20'
			none	7.0	440	0.0	4.8	108.4	14.2	99.0	
			none	7.0	510	—	4.8	108.4	24.2	89.0	
A-10	9/25/78	pale orange brown	slight	6.8	2430	1.0	4.8	108.4	5-25	88-108	Bailed 2½ gallons
	10/11/78	—	—	—	—	—	4.7	108.5	—	—	
	10/17/78	—	—	—	—	—	4.5	108.7	—	—	
A-11	9/8/78	pale yellow	mod	6.6	2050	1.0	5.1	106.9	6.6	105.4	Distinctive odor of alcohol in G.W.
		pale yellow	mod	6.6	2010	1.0	5.1	106.9	13.8	98.2	
	9/25/78	Access to well prohibited; problem with adjacent volatile solvent tank.									
A-13	10/11/78	—	—	—	—	—	4.9	107.1	—	—	
	10/17/78	—	—	—	—	—	4.6	107.4	—	—	
	9/8/78	brown	mod	6.4	1040	1.0	3.7	108.8	4.4	108.1	
A-14	9/25/78	pale yellow	mod	6.5	690	0.0	—	—	2-5	107-110	
	10/11/78	—	—	—	—	—	3.1	109.4	—	—	
	10/17/78	—	—	—	—	—	2.9	109.6	—	—	
A-13	9/25/78	orange brown	slight	6.4	1250	1.2	5.4	108.8	10-25	89-104	Slotted from 10'-25'
	10/11/78						5.6	108.6	—	—	
	10/17/78						5.3	108.9	—	—	
A-14	9/7/78	pale gray	slight	6.1	1950	0.9	—	—	—	—	4 hrs after complete
	9/8/78	pale yellow	mod	4.7	2220	1.1	4.9	109.1	6.4	—	
			mod	4.7	2320		4.9	109.1	13.8	—	
	9/25/78	light gray	slight	5.0	2650	1.2	4.8	109.2	5-15	99-109	
	10/11/78	—	—	—	—	—	4.8	109.2	—	—	
	10/17/78	—	—	—	—	—	4.6	109.4	—	—	

TABLE NO. 1745-W-1.9-8

December 20, 1978

PLATE NO. AGR-C-5

GROUNDWATER QUALITY DATA SUMMARYMULTI-LEVEL OBSERVATION WELL A-1

SAMPLE INVENTORY AND FIELD ANALYSIS								
Date	Well #	Color	Odor	Salinity ‰	Conductivity μmhos/cm	pH (Field)	Ground Water Depth (Ft.BGS)	Ground Water Elev.
5/27/78	A-1-1	—	Moderate	—	—	—	3.6	109.0
5/27/78	A-1-2	—	Very Strong	—	—	5.0-5.5	—	—
5/27/78	A-1-3	—	Slight	—	—	5.0-5.6	—	—
7/27/78	A-1-1	—	Very Strong	—	—	3.0	—	—
7/27/78	A-1-2	—	Very Strong	—	—	5.0	—	—
7/27/78	A-1-3	—	None	—	—	6.5	—	—
8/28/78	A-1-1	Orange Brown	Moderate	2.2	4,200	3.3	2.8	109.8
8/28/78	A-1-2	Orange Brown	Moderate	3.8	11,000	5.7	—	—
8/28/78	A-1-3	—	None	0.0	620	8.2	—	—
9/7/78	A-1-1	Orange Brown	Strong	3.0	4,850	3.7	3.2	109.4
9/7/78	A-1-2	Orange Brown	Strong	6.9	10,900	5.7	—	—
9/7/78	A-1-3	—	None	0.0	490	8.4	—	—
9/25/78	A-1-1	Orange Brown	Strong	3.0	5,000	3.8	3.9	108.7
9/25/78	A-1-2	Orange Brown	Strong	6.8	10,900	5.8	—	—
9/25/78	A-1-3	—	Very Slight	0.0	500	7.8	—	—
10/11/78	A-1-1	—	—	—	—	—	3.4	109.2
10/17/78	A-1-1	—	—	—	—	—	2.8	109.8

NOTE: Sampling intervals:

A-1-1 → 2.5' to 12.5' below ground surface (Elev. 100.0 to 110.1)

A-1-2 → 20' to 22' below ground surface (Elev. 90.6 to 92.6)

A-1-3 → 30' to 32' below ground surface (Elev. 80.6 to 82.6)

LABORATORY ANALYSIS

Well #	Conductivity	pH	Acidity	Alkalinity	Chloride	Calcium	Magnesium	Iron	Sulfate
	Field	Field							
A-1-1	5,000	3.8	240	—	149	560	82.69	102.75	1546.3
	4,900	3.3							
A-1-2	10,900	5.8	—	110	798	440	972.80	3206.00	2569.4
	10,900	4.6							
A-1-3	500	7.8	—	140	133	8	4.86	20.97	28.7
	510	7.0							

NOTES: (1) All concentrations reported in parts per million.

(2) Sample collected 9/25/78; analysis 11/15/78.

TABLE NO. 1745-W-1.9-9

December 20, 1978

PLATE NO. AGR-C-6

GROUNDWATER QUALITY DATA SUMMARYMULTI-LEVEL OBSERVATION WELL A-2

Date	Well #	Color	Odor	pH (Field)	Conductivity μmhos/cm	Salinity o/oo	Groundwater (Ft. BGS)	Groundwater Elevation	Remark
9/11/78	A-2-1	—	—	—	—	—	—	—	Sampled three hours after completion.
9/11/78	A-2-2	pale yellow	slight	6.7	1,630	0.5	—	—	"
9/11/78	A-2-3	light gray	none	8.0	460	0.0	—	—	"
9/25/78	A-2-1	orange brown	mod	6.5	2,650	1.1	—	—	Slight oil film? No chemical analysis.
9/25/78	A-2-2	light brown	strong	6.2	13,100	8.2	—	—	"
9/25/78	A-2-3	none	none	8.1	400	0.0	—	—	"
10/17/78	A-2-1	—	—	—	—	—	4.9	109.4	"

NOTES: (1) No laboratory analyses were performed on samples from these wells.

(2) Intervals sampled:

A-2-1 1' to 10' below ground surface (Elev. 103.1 to 112.1)

A-2-2 17' to 19' below ground surface (Elev. 94.1 to 96.1)

A-2-3 26.5' to 28.5' below ground surface (Elev. 84.6 to 86.6)

TABLE NO. 1745-W-1.9-10

December 20, 1978

PLATE NO. AGR-C-7

DPW00427

GROUNDWATER QUALITY DATA SUMMARY
MULTI-LEVEL OBSERVATION WELL A-3

SAMPLE INVENTORY AND FIELD ANALYSIS											
Date	Well #	Color	Odor	Salinity °/oo	Conductivity µmhos/cm	pH (Field)	Ground Water Depth (Ft.BGS)	Ground Water Elev.			
9/14/78	A-3-1	Yellow	None	0.1	1020	6.9	6.6	108.1			
9/14/78	A-3-2	Pale Gray	None	0.0	560	8.4	—	—			
9/14/78	A-3-3	Pale Gray	None	0.0	580	8.5	—	—			
9/25/78	A-3-1	Pale Yellow	Very Slight	0.4	1440	6.5	7.0	107.7			
9/25/78	A-3-2	—	None	0.0	860	7.9	—	—			
9/25/78	A-3-3	Light Gray	None	0.01	900	8.4	—	—			
10/11/78	A-3-1	—	—	—	—	—	6.6	108.1			
10/17/78	A-3-1	—	—	—	—	—	6.3	108.4			
NOTE: Sampling intervals: A-3-1 → 2' to 12' below ground surface (Elev. 102.6 to 112.6) A-3-2 → 20.5' to 22.5' below ground surface (Elev. 92.2 to 94.2) A-3-3 → 30' to 32' below ground surface (Elev. 82.7 to 84.7)											
LABORATORY ANALYSIS											
Well #	Conductivity		pH		Acidity	Alkalinity	Chloride	Calcium	Magnesium	Iron	Sulfate
	Field	Lab	Field	Lab							
A-3-1	1,440	1,400	6.5	6.9	—	380	133	240	14.59	6.29	302.6
A-3-2	860	850	7.9	8.2	—	236	148	16	4.86	27.96	81.1
A-3-3	900	900	8.4	8.5	—	389	103	14.4	0.97	36.35	17.6
NOTES: (1) All concentrations reported in parts per million. (2) Sample collected 9/25/78; analyzed 11/15/78.											
TABLE NO. 1745-W-1.9-11				December 20, 1978				PLATE NO. AGR-C-8			

GROUNDWATER QUALITY DATA SUMMARY
MULTI-LEVEL OBSERVATION WELL A-4

SAMPLE INVENTORY AND FIELD ANALYSIS								
Date	Well #	Color	Odor	Salinity °/oo	Conductivity μ mhos/cm	pH (Field)	Ground Water Depth (Ft.BGS)	Ground Water Elev.
9/14/78	A-4-1	Pale Yellow	Moderate	1.0	1920	6.6	5.3	109.1
9/14/78	A-4-2	Faint Yellow	Slight	0.1	970	8.0	—	—
9/14/78	A-4-3	None	None	0.0	460	8.2	—	—
9/25/78	A-4-1	Pale Orange	Moderate	1.0	2350	6.5	5.6	108.8
9/25/78	A-4-2	None	Slight	0.5	1560	7.9	—	—
9/25/78	A-4-3	None	Very Slight	0.0	520	8.0	—	—
10/11/78	A-4-1	—	—	—	—	—	5.5	108.9
10/17/78	A-4-1	—	—	—	—	—	4.0	110.4

NOTE: Sampling intervals:

A-4-1 → 4.5' to 13' below ground surface (Elev. 101.4 to 109.9)

A-4-2 → 20.2' to 22.2' below ground surface (Elev. 92.2 to 94.2)

A-4-3 → 33.8' to 35.8' below ground surface (Elev. 78.6 to 80.6)

LABORATORY ANALYSIS

Well #	Conductivity	pH	Acidity	Alkalinity	Chloride	Calcium	Magnesium	Iron	Sulfate
	Field	Field							
	Lab	Lab							
A-4-1	2350	6.5	—	390	66	640	25.3	23.1	1140.8
	2400	7.0							
A-4-2	1560	7.9	—	244	103	140	36.5	2.1	422.2
	1470	7.2							
A-4-3	520	8.0	—	90	193	56	7.3	1.4	16.3
	540	7.7							

NOTES: (1) All concentrations reported in parts per million.

(2) Sample collected 9/25/78; analyzed 11/15/78.

TABLE NO. 1745-W-1.9-12

December 20, 1978

PLATE NO. AGR-C-9

DPW00430



ANUS WM. RICE DIVISION

Mr. Charles W. Amelotti
SVERDRUP & PARCEL & ASSOCIATES, INC.
800 North 12th Boulevard
St. Louis, MO 63101

ANALYTICAL SERVICES LABORATORY
15 N. AVENUE • PITTSBURGH, PA. 15203
412-343-9200

Client No. Q
Date Sampled 3-30-79
Date Received 4-3-79
Date Reported 5-25-79

Test results reported in mg/liter unless otherwise noted.

Rice Sample No.	
19040106	S&P A-1-2
	The following compounds were identified by GC/MS in the sample following EPA priority pollutant protocol procedures (PP) for sample preparation:
	Concentration, ug/liter <i>PPB</i>
	Volatile Organic Compounds
	Methylene Chloride 1300
	Chloroform 60
	1,1,1-Trichloroethane 1
	Trichloroethylene 1
	Benzene 4
	Tetrachloroethylene 5
	Toluene 1
	Ethylbenzene 4
	2,2'-Thio-bis-propane 500
	Freon TF 20
	2-Propanol 10
	Extractable Organic Acid Compounds
	Phenol 32
	2,4-Dimethyl Phenol 96
	"Methyl Phenols" 400
	"Dimethyl Phenols" 1000
	Benzoic Acid 2000
	"Methylbenzoic Acids" >5000
	"Benzamide and Methylbenzamides" 1500
	Naphthalene 250
	Extractable Organic Base Neutral Compounds
	Naphthalene 10
	Dimethyl Phthalate 20
	Diethyl Phthalate 5
	"Methyl Anilines" 400
	"Methyl Phenols" 200
	"Dimethyl Phenols" 3000
	"Methyl Benzamides" 400
	Extractable Pesticide Compounds
	None Detected by GC/EC

DPW00431

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Mr. Charles W. Amelotti

Page 2

May 25, 1979

19040106 S&P A-1-2 (cont'd)

Static headspace was sampled with a 5.0-ml gas-tight syringe, the syringe was connected to the purger in the usual manner and the PP procedure followed. The following compounds were identified by GC/MS:

Headspace Volatile Organic Compounds	Concentration ug/liter of air
Methylene Chloride	550
Benzene	6
Tetrachloroethylene	3
2,2'-Thio-bis-propane	300
Freon TF	150
Carbon Disulfide	15

The headspace was sampled again at a later date. The sample was run by GC/TC. There was indication that it contained methane and formaldehyde. However these compounds were not confirmed.

A 500-ml portion of the original sample which had been filtered through glass wool (pH 3.9) was serially extracted with three 100-ml portions of methylene chloride. The dissolved methylene chloride was removed by heating on the steam bath. Ferrous iron, ferric oxide and calcium sulfate were positively identified in the water. After removal of the iron and calcium with sodium carbonate a pale yellow solution remained.

The yellow solution was allowed to evaporate at approximately 40°C. Solids formed were removed by filtration at two different times. The infrared spectra of the solids indicated sulfonic acid (sulfonate), bonded hydroxyl, imido, or amido groups, and substituted benzene rings. No positive identification of any compound was made.

By lowering the pH of the solution to below 1.0 the color became a purple-red.

It is suspected that the solution contained a mixture of sulfonates and water soluble "tar" acids.

DPW00432

DPW00433

TABLE 2. SUMMARY OF ANALYTICAL RESULTS

Compound	Sample (values in µg/l)		
	Ground water	Trench soil	Solidified sludge
	(GCA No. 15394 and 15396)	(GCA No. 15392)	(GCA No. 15393)
<u>Priority Pollutants</u>			
Phenol, 2,4-dimethyl	300	350	
Naphthalene	380		2,300
Phenanthrene	20		
<u>Nonpriority Pollutants</u>			
Propane, 2,2'-thiobis-	5,000		
Pyridine, 4-methyl	280		
Pyridine, 2,6-dimethyl	140		
Pyridine, 4-ethyl	130		
Pyridine, 2,4-dimethyl	160		
Pyridine, 2,4,6-trimethyl	8.0		
Quinoline	8,200		4,900
Isoquinoline	2,000		2,400
Naphthalene, 1- or 2-methyl	180		
Quinoline, methyl- or Isoquinoline, methyl isomer	410		
Quinoline, 5-, 6-, or 7-methyl	150		
Naphthalene, 1- or 2-carboxylic acid			4,600
Naphthalene, 1- (2-naphthalenyl methyl)			5,600

TABLE 3. DETECTION LIMITS FOR PRIORITY POLLUTANTS

GCA Control Number	Sample Identification	Detection limits for priority pollutants
15392	Soil Sample, Seq 1	240 µg/kg (ppb) based on wet
15393	Soil Sample, Seq 2	270 µg/kg (ppb) weight of soil
	Water Sample, Seq 3	
15396	Base/Neutral and Acid Extractables	10 µg/l (ppb)
15394	Volatile Organics	50 µg/l (ppb)

DPW00434